CLAIMS

1. An exhaust purification device for an internal combustion engine designed to purify NO_x generated when burning fuel under a lean air-fuel ratio by an exhaust purification catalyst arranged in an exhaust passage, said exhaust purification device using as a catalyst carrier of said exhaust purification catalyst a carrier having base points on the carrier surface, carrying a precious metal catalyst dispersed on the carrier surface without forming a layer of a NO_x absorbent able to absorb NO_x, and temporarily switching the air-fuel ratio of the exhaust gas flowing into the exhaust purification catalyst from lean to rich before the entire surface of the precious metal catalyst suffers from oxygen poisoning.

2. An exhaust purification device for an internal combustion engine as set forth in claim 1, wherein said catalyst carrier is comprised of alumina.

3. An exhaust purification device for an internal combustion engine as set forth in claim 2, wherein said catalyst carrier is made to contain inside it an alkali metal, an alkali earth metal, or a rare earth so as to increase the number of base points on the catalyst carrier surface or strengthen the basicity at the base points.

4. An exhaust purification device for an internal combustion engine as set forth in claim 1, wherein said precious metal catalyst is platinum.

5. An exhaust purification device for an internal combustion engine as set forth in claim 1, wherein the oxygen poisoning of the precious metal catalyst is continuously eliminated by the air-fuel ratio of the exhaust gas being repeatedly switched from lean to rich and wherein the ratio of a rich time to a lean time at this time is set to a ratio giving a NO_x purification rate of 90 percent or more when the temperature of the exhaust purification catalyst is 200°C to 250°C.

6. An exhaust purification device for an internal combustion engine as set forth in claim 1, wherein the oxygen poisoning of the precious metal catalyst is continuously eliminated by the air-fuel ratio of the exhaust gas being repeatedly switched from lean to rich and wherein the action of switching the air-fuel ratio from lean to rich is prohibited when the temperature of the exhaust purification catalyst is an allowable temperature or more.

7. An exhaust purification device for an internal combustion engine as set forth in claim 1, wherein said device is further provided with means for calculating an amount of oxygen poisoning of the precious metal catalyst and wherein the air-fuel ratio of the exhaust gas is switched from lean to rich when the calculated amount of oxygen poisoning exceeds a predetermined allowable value.

8. An exhaust purification device for an internal combustion engine as set forth in claim 1, wherein said device is further provided with means for estimating an amount of oxygen poisoning of the precious metal catalyst and wherein the air-fuel ratio of the exhaust gas is switched from lean to rich when the estimated amount of oxygen poisoning exceeds a predetermined allowable value.

9. An exhaust purification device for an internal combustion engine as set forth in claim 8, wherein said device is further provided with a NO_x concentration sensor for detecting the concentration of NO_x in exhaust gas flowing out from the exhaust purification catalyst and wherein it is judged that the amount of oxygen poisoning of the precious metal catalyst has exceeded the allowable value when the concentration of NO_x detected by the NO_x concentration sensor has exceeded a set value.

10. An exhaust purification device for an internal combustion engine as set forth in claim 1, wherein said device is further provided with means for judging if the oxygen poisoning of the precious metal catalyst has been eliminated and wherein the air-fuel ratio of the exhaust

gas is switched from rich to lean when it is judged that the oxygen poisoning of the precious metal catalyst has been eliminated.

11. An exhaust purification device for an internal combustion engine as set forth in claim 10, wherein said device is further provided with an air-fuel ratio sensor for detecting an air-fuel ratio of the exhaust gas flowing out from the exhaust purification catalyst and wherein it is judged that oxygen poisoning of the precious metal catalyst has been eliminated when the air-fuel ratio of the exhaust gas flowing out from the exhaust purification catalyst becomes rich after the air-fuel ratio of the exhaust gas flowing into the exhaust purification catalyst is switched from lean to rich.

12. An exhaust purification device for an internal combustion engine as set forth in claim 1, wherein the NO_x and SO_x contained in the exhaust gas are oxidized by the precious metal catalyst in the exhaust purification catalyst, then held on the catalyst carrier.

13. An exhaust purification device for an internal combustion engine as set forth in claim 12, wherein the NO_x held on the catalyst carrier is released from the catalyst carrier and reduced when the air-fuel ratio of the exhaust gas flowing into the exhaust purification catalyst is temporarily switched from lean to rich to eliminate the oxygen poisoning of the precious metal catalyst.

14. An exhaust purification device for an internal combustion engine as set forth in claim 12, wherein the strength of the basicity of the surface of the catalyst carrier is set to a strength by which the SO_x is held on the surface of the catalyst carrier in the form of sulfate ions.

15. An exhaust purification device for an internal combustion engine as set forth in claim 14, wherein when getting the SO_x held on the surface of the catalyst carrier released from the surface of the catalyst

carrier, the temperature of the exhaust purification catalyst is made to rise to the SO_x release temperature, then the air-fuel ratio of the exhaust gas is made rich while the temperature of the exhaust purification catalyst is maintained at the SO_x release temperature, and the SO_x release temperature is about 500°C to 550°C.

16. An exhaust purification device for an internal combustion engine as set forth in claim 1, wherein a particulate filter is arranged in the engine exhaust passage instead of said exhaust purification catalyst and the catalyst carrier is coated on the particulate filter.

17. An exhaust purification device for an internal combustion engine as set forth in claim 1, wherein a particulate filter is arranged in the engine exhaust passage and said exhaust purification catalyst is arranged in the exhaust passage upstream or downstream of the particulate filter.

18. An exhaust purification device for an internal combustion engine as set forth in claim 1, wherein the engine exhaust passage has arranged in it a NO_x selective reducing catalyst having the function of selectively reducing the NO_x and not having the function of absorbing NO_x and wherein said exhaust purification catalyst is arranged in the exhaust passage upstream or downstream of said NO_x selective reducing catalyst.

19. An exhaust purification device for an internal combustion engine as set forth in claim 18, wherein the exhaust purification catalyst is arranged in the exhaust passage upstream of the NO_x selective reducing catalyst, a urea feed valve for feeding a urea aqueous solution is provided in the exhaust passage between the NO_x selective reducing catalyst and exhaust purification catalyst, the air-fuel ratio of the exhaust gas is repeatedly switched from lean to rich when a high NO_x purification rate is obtained by the exhaust purification catalyst, and the urea aqueous solution is fed from the urea feed valve when a high NO_x purification rate is obtained by the NO_x

selective reducing catalyst.

20. An exhaust purification device for an internal combustion engine as set forth in claim 1, wherein a NO_x storing catalyst, forming on the surface of the carrier a layer of a NO_x absorbent able to absorb NO_x under a lean air-fuel ratio and carrying a precious metal catalyst dispersed on it, is arranged in the engine exhaust passage in series with said exhaust purification catalyst, the air-fuel ratio of the exhaust gas flowing into the exhaust purification catalyst is temporarily switched from lean to rich before the entire surface of the precious metal catalyst carried on the carrier surface of the exhaust purification catalyst suffers from oxygen poisoning when the NO_x in the exhaust gas is mainly being purified by the exhaust purification catalyst, and the air-fuel ratio of the exhaust gas flowing into the NO_x storing catalyst is temporarily switched from lean to rich before the NO_x storing capability of the NO_x storing catalyst becomes saturated when the NO_x in the exhaust gas is mainly being purified by the NO_x storing catalyst.

21. An exhaust purification device for an internal combustion engine as set forth in claim 20, wherein the NO_x in the exhaust gas is mainly purified by the exhaust purification catalyst when a temperature of the exhaust purification catalyst is in a first temperature region, and the NO_x in the exhaust gas is mainly purified by the NO_x storing catalyst when a temperature of the NO_x storing catalyst is in a second temperature region at a side higher than said first temperature region.

22. An exhaust purification device for an internal combustion engine as set forth in claim 21, wherein it is judged that the temperature of the exhaust purification catalyst is in the first temperature range when a representative temperature representing the temperature of the exhaust purification catalyst and the temperature of the NO_x storing catalyst is lower than a predetermined set temperature, it is judged that the temperature of the

NO_x storing catalyst is in the second temperature range when said representative temperature is higher than the predetermined set temperature, the air-fuel ratio of the exhaust gas flowing into the exhaust purification catalyst is temporarily switched from lean to rich before the entire surface of the precious metal catalyst carried on the carrier surface of the exhaust purification catalyst suffers from oxygen poisoning when it is judged that the temperature of the exhaust purification catalyst is in the first temperature region, and the air-fuel ratio of the exhaust gas flowing into the NO_x storing catalyst is temporarily switched from lean to rich before the NO_x storing capability of the NO_x storing catalyst becomes saturated when it is judged that the temperature of the NO_x storing catalyst is in the second temperature region.

23. An exhaust purification device for an internal combustion engine as set forth in claim 20, wherein the NO_x absorbent carried on the surface of the carrier of the NO_x storing catalyst is comprised of an alkali metal, an alkali earth metal, or a rare earth.

24. An exhaust purification device for an internal combustion engine as set forth in claim 20, wherein the NO_x and SO_x contained in the exhaust gas are absorbed in the NO_x absorbent carried on the surface of the carrier of the NO_x storing catalyst under a lean air-fuel ratio.

25. An exhaust purification device for an internal combustion engine as set forth in claim 24, wherein the device is provided with means for calculating an amount of NO_x absorbed in the NO_x absorbent and wherein the air-fuel ratio of the exhaust gas is switched from lean to rich when the calculated amount of NO_x absorbed exceeds a predetermined allowable value.

26. An exhaust purification device for an internal combustion engine as set forth in claim 24, wherein said device is further provided with means for estimating an amount of NO_x absorbed in the NO_x absorbent and wherein

the air-fuel ratio of the exhaust gas is switched from lean to rich when the estimated amount of the NO_x absorbed exceeds a predetermined allowable value.

27. An exhaust purification device for an internal combustion engine as set forth in claim 24, wherein said device is further provided with a NO_x concentration sensor for detecting the concentration of NO_x in exhaust gas flowing out from the NO_x storing catalyst and wherein it is judged that the amount of NO_x absorbed of the NO_x absorbent has exceeded the allowable value when the concentration of NO_x detected by the NO_x concentration sensor has exceeded a set value.

28. An exhaust purification device for an internal combustion engine as set forth in claim 24, when getting the SO_x absorbed in the NO_x absorbent of the NO_x storing catalyst released from the NO_x absorbent, the temperature of the NO_x storing catalyst is made to rise to the SO_x release temperature, then the air-fuel ratio of the exhaust gas is made rich while the temperature of the NO_x storing catalyst is maintained at the SO_x release temperature, and the SO_x release temperature is about 600°C or more.

29. An exhaust purification device for an internal combustion engine as set forth in claim 20, wherein the order of arrangement of the exhaust purification catalyst and the NO_x storing catalyst is determined in accordance with the strength of the basicity of the catalyst and the catalyst with the stronger basicity is arranged at the upstream side of the catalyst with the weaker basicity.

30. An exhaust purification device for an internal combustion engine as set forth in claim 29, wherein the NO_x storing catalyst is arranged at the upstream side of the exhaust purification catalyst.

31. An exhaust purification device for an internal combustion engine as set forth in claim 30, wherein an acidic catalyst is arranged at an upstream side of the NO_x storing catalyst.

32. An exhaust purification device for an internal combustion engine as set forth in claim 20, wherein the NO_x storing catalyst is arranged upstream of the exhaust purification catalyst.

33. An exhaust purification device for an internal combustion engine as set forth in claim 32, wherein the NO_x storing catalyst is comprised of a particulate filter.

34. An exhaust purification device for an internal combustion engine as set forth in claim 20, wherein the NO_x storing catalyst is arranged downstream of the exhaust purification catalyst.

35. An exhaust purification device for an internal combustion engine as set forth in claim 34, wherein the NO_x storing catalyst is comprised of a particulate filter.

36. An exhaust purification device for an internal combustion engine as set forth in claim 20, wherein exhaust purification catalysts are arranged upstream and downstream of the NO_x storing catalyst.

37. An exhaust purification device for an internal combustion engine as set forth in claim 36, wherein the NO_x storing catalyst is comprised of a particulate filter.

38. An exhaust purification device for an internal combustion engine as set forth in claim 1, wherein a reducing agent is fed into the engine exhaust passage to make the air-fuel ratio of the exhaust gas rich.

39. An exhaust purification device for an internal combustion engine as set forth in claim 1, wherein the engine is an engine which gradually increases in amount of generation of soot and reaches a peak when increasing the amount of exhaust gas recirculation and no longer generates almost any soot when further increasing the amount of exhaust gas recirculation and wherein the air-fuel ratio of the exhaust gas is made rich by making the air-fuel ratio in the combustion chamber rich in the state where the amount of exhaust gas recirculation is increased over the amount where the amount of generation of soot peaks.

40. An exhaust purification device for an internal combustion engine as set forth in claim 1, wherein the engine is an engine which gradually increases in amount of generation of soot and reaches a peak when increasing the amount of exhaust gas recirculation and no longer generates almost any soot when further increasing the amount of exhaust gas recirculation and wherein the amount of exhaust gas recirculation is increased over the amount where the amount of generation of soot peaks when the temperature of the exhaust purification catalyst should be raised.